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(71) Applicant: MITSUBISHI JUKOGYO KABUSHIKI KAISHA
Tokyo 100 (JP)

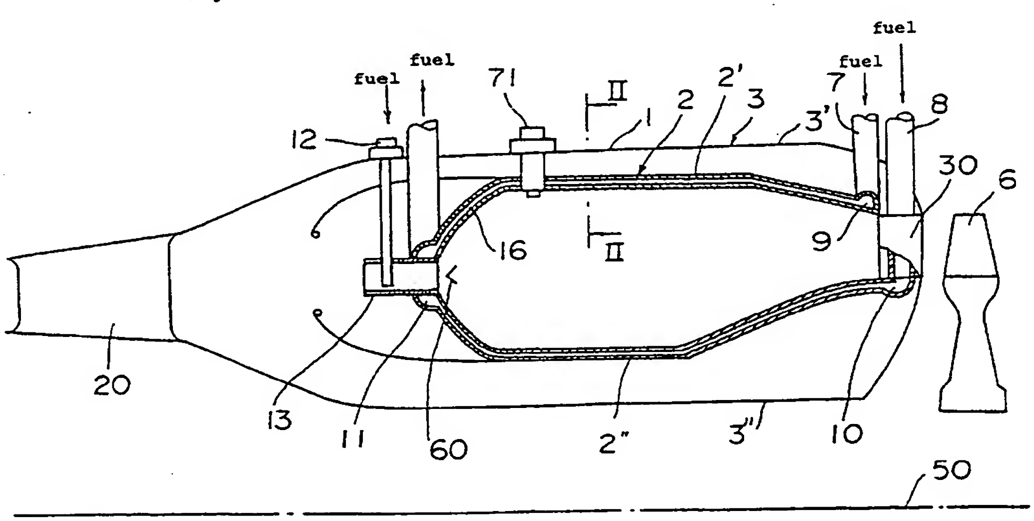
(72) Inventor: Matsuhama, Masaaki,
Nagoya Guid & Pro. sys.
Komaki-shi, Aichi-ken (JP)

(74) Representative: Henkel, Feiler, Hänzel & Partner
Möhlstrasse 37
81675 München (DE)

(54) **Gas turbine combustor**

(57) A gas turbine combustor in which an inequality of distribution of temperature at the outlet of the combustor which is caused by cooling air introduced to the combustor to cool it is prevented. A liner 2 having an outer liner 2' and an inner liner 2" is disposed within a casing 3 composing the gas turbine combustor 1. The liner 2 is composed of a liner inner cylinder 15 in which liner cooling paths 16 are created and a liner outer cylinder 14. Fuel supplied via upstream side manifolds 9 and 10 flows through the liner cooling paths 16 and is discharged from a downstream side manifold 11 after cooling the liner 2. The fuel is boosted by a pump and is supplied to a fuel-air pre- mixer 13 from a fuel supply port 12 to be burned in the combustion chamber.

Fig. 4



EP 0 725 253 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a gas turbine combustor using liquid fuel as its fuel and more particularly to a gas turbine combustor for an aircraft engine.

Description of the Related Art

FIG. 11 shows a prior art gas turbine combustor. In the figure, the gas turbine combustor 1 comprises a cylindrical casing 3 composed of an outer casing 3' and an inner casing 3" centered on a center line 50 of rotation of a turbine rotor blade 6 and a cylindrical liner 2, composed of an outer liner 2' and an inner liner 2", which is disposed within the casing 3 concentrically therewith.

Formed through the outer liner 2' and the inner liner 2" are an air hole 40 for supplying combustion air to a combustion chamber to form a flame holding area and a slot 41 for supplying dilution air to the combustion chamber to lower a temperature of combustion gas to a predetermined turbine inlet temperature and to reduce NOx.

Air supplied from a compressor to a space between the casing 3 and the liner 2 flows toward the turbine along the liner 2 and cools the outer surface of the liner 2. During that, a part thereof flows into the combustion chamber from the air hole 40 described above and the other part thereof flows into the combustion chamber from the slot 41 and cools the inner surface of the liner 2.

It is noted that a guide vane 20 at an outlet of the compressor is provided at the upstream side of the casing 3, a turbine nozzle 30 is provided at the downstream end of the casing 3 and a fuel supply inlet 12, a fuel-air pre-mixer 13 and an igniter 71 are provided as shown in the figure.

Then, because the air for cooling the liner 2 flows into the combustion chamber partially from the air hole 40 and the slot 41 as described above, there have been problems that the liner 2 is not cooled equally and that a hot spot is apt to be created at the downstream area of the air hole 40, causing a melt-down by which the part thereof is melt and lost.

It is caused, partially, because a balanced temperature of the liner 2 cannot but become high because the liner 2 is cooled by air having a bad heat transfer characteristic and because, due to that, it cannot but use a liner material such as hastelloy X whose thermal conductivity is bad, though its high temperature strength is high.

Accordingly, it is a primary object of the present invention to provide a gas turbine combustor which allows to prevent such a hot spot which leads to the melt-down from being produced and to use a material having a good thermal conductivity, though a high temperature strength thereof is small, as a liner material by cooling the liner 2 equally by liquid fuel having a heat transfer characteristic higher than that of air.

SUMMARY OF THE INVENTION

In order to solve the aforementioned problems of the gas turbine combustor having the liner forming the combustion chamber and the fuel-air pre-mixer, provided within and at the upstream side of the liner, for mixing liquid fuel with air supplied from the compressor and supplying it to the combustion chamber, according to the present invention, a gas turbine combustor constructed as follows is provided.

A first gas turbine combustor of the present invention comprises a casing whose upstream side is connected with the outlet side of the compressor and whose downstream side is connected with the downstream side of the liner and which forms a space between it and the liner; a plurality of flow paths, provided within the liner, for flowing liquid fuel in the longitudinal direction of the liner; means, provided at one end of the liner, for supplying liquid fuel to the fuel paths; means, provided at the other end of the liner, for discharging the liquid fuel from the fuel paths; and an air hole, created through the liner, for supplying air supplied from the compressor to the space between the casing and the liner to the combustion chamber as combustion air to produce a flame holding area.

According to the gas turbine combustor constructed as described above, the liquid fuel is flown to the flow paths provided within the liner and cools the liner equally, so that no hot spot which might otherwise be produced at the downstream portion of the air hole is produced and a material having a good heat transfer characteristic, though its high temperature strength is small, may be used as a material of the liner.

Next, a second gas turbine combustor of the present invention provided to solve the aforementioned problems has a structure in which the air hole which has been provided through the liner in the first gas turbine combustor of the present invention is eliminated and flame holding area producing means is provided at the downstream side of the fuel-air pre-mixer.

Because no air hole is provided through the liner, the gas turbine combustor constructed as described above has effects that the fuel flow paths within the liner may be readily formed and that an inequality of distribution of combustion gas temperature at the outlet of the combustor which would otherwise be caused by the air hole may be prevented, in addition to the effects of the first gas turbine combustor described above.

Further, a third gas turbine combustor of the present invention provided to solve the aforementioned problems has a structure in which the downstream side of the casing whose upstream side is connected with the outlet side of the compressor is connected with the

upstream side of the liner in the second gas turbine combustor described above.

By constructing as described above, a function as a casing is given to the liner, so that the size of the combustor may be reduced by eliminating the space between the liner and the casing and thereby, the length of the shaft connecting the compressor with the turbine may be shortened and the size and weight of the combustor and the whole system may be reduced, in addition to the effects obtained in the gas turbine combustor of the second invention described above.

It is preferable to construct the third gas turbine combustor of the present invention so that the liner has a double-layer structure with an outer cylinder and an inner cylinder in which the fuel flow paths are created and so that the inner cylinder is made of a material having a high heat transfer characteristic and the outer cylinder is made of a material having a high strength to be able to improve the liner cooling effect and to enhance the strength of the combustor itself, in addition to the aforementioned effects.

It is also preferable to construct the first through third gas turbine combustors of the present invention so that a sectional shape of the fuel path within the liner perpendicular to the direction of the flow is approximately square and so that the section face of the combustion chamber side projects in the direction opposite from the combustion chamber in order to equalize a temperature distribution in the liner face in the fuel paths and to prevent calking of fuel which might otherwise be caused by a partially increased temperature of the fuel flowing through the flow path on the side of the combustion chamber.

Further, in the first through third gas turbine combustors of the present invention, it is preferable to provide means for detecting a temperature of fuel flowing through each of the fuel paths created within the liner at the fuel discharge side and to provide means for controlling an amount of fuel supplied to each fuel path in accordance to the detected fuel temperature at the fuel supply side in order to equalize the liner temperature and to prevent a local melt-down of the liner and the calking of fuel.

Or, in the first through third gas turbine combustor of the present invention, it is preferable to provide means for detecting a temperature of combustion gas discharged from the liner in the direction of center line of the axis of rotation of the fuel-air pre-mixer and to provide means for controlling an amount of air supplied to the combustion chamber in accordance to the detected combustion gas temperature at the upstream side of the the fuel-air pre- mixer within the liner in order to equalize the distribution of temperature of the combustion gas at the outlet of the combustor which might otherwise vary due to the circumferential distribution of air supplied from the compressor and to obtain a high efficient turbine output.

The above and other related objects and features of the present invention will be apparent from a reading of the following description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a structural drawing of a gas turbine combustor according to a first embodiment of the present invention;
FIG. 2 is a section view along a line II-II in FIG. 1;
FIG. 3 is a section view along a line III-III in FIG. 2;
FIG. 4 is a structural drawing of a gas turbine combustor according to a second embodiment of the present invention;
FIG. 5 is a structural drawing of a gas turbine combustor according to a third embodiment of the present invention;
FIG. 6 is a section view along a line IV-IV in FIG. 5;
FIG. 7 is a section view showing a structure of a liner in a gas turbine combustor according to a fourth embodiment of the present invention;
FIG. 8 is a graph for explaining an operation of the liner in the gas turbine combustor according to the fourth embodiment of the present invention;
FIG. 9 is a structural drawing of a gas turbine combustor according to a fifth embodiment of the present invention;
FIG. 10 is a structural drawing of a gas turbine combustor according to a sixth embodiment of the present invention; and
FIG. 11 is a structural drawing of a prior art gas turbine combustor.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A gas turbine combustor of the present invention will be explained below concretely based on preferred embodiments thereof shown in FIGs. 1 through 10. It is noted that in order to simplify the explanation, the same reference numerals refer to corresponding parts of the prior art unit shown in FIG. 11 throughout several views.

[First Embodiment]

The first embodiment of the present invention will be explained below with reference to FIGs. 1 through 3. A liner 2 has a double-layer structure composed of a liner outer cylinder 14 and a liner outer cylinder 15 as shown in a section view thereof in FIG. 2. A plurality of fuel paths 16, each having a square section and formed in the longitudinal direction of the liner 2, are provided in the circumferential direction the liner 2.

Further, as shown in FIG. 3, an air hole 40 is created through the liner inner cylinder 15 and the liner outer cylinder 14 and the fuel paths 16 detour the part where there is the air hole 40.

Fuel (Jet-A, liquid hydrogen, liquid methane, etc.) introduced from the outside via fuel supply pipes 7, and

8 and downstream manifolds 9 and 10 is supplied to the fuel paths 16 and flows to the upstream side, thereby absorbing heat of the liner 2 and cooling the liner 2 equally.

Thereby, no hot spot is created at the downstream part of the air hole 40 because the fuel paths 16 are formed also around the air hole 40 as described above. Further, because the liner 2 is cooled thus by the liquid fuel having a high heat transfer characteristic, a material (e.g. copper) having a good thermal conductivity, even if its high temperature strength is small, may be used as a material of the liner.

The high temperate fuel arriving at the upstream side of the liner is discharged outside of the combustor 1 via an upstream side manifold 11, boosted to a predetermined pressure by a fuel pump not shown and then supplied to a fuel-air pre-mixer 13 via a fuel supply port 12.

Meanwhile, part of air supplied from the compressor to the space between the casing 3 and the liner 2 flows into the combustion chamber from the air hole 40 as combustion air and produces a flame holding area within the combustion chamber, thus holding a continuous and stable combustion. Dilution air is supplied to the combustion chamber via the fuel-air pre-mixer 13.

It is noted that when a pressure of the fuel obtained at the upstream side manifold 11 is fully high, the fuel may be supplied directly to the fuel supply port 12 without sending to the fuel pump. Further, it is not necessary to supply all the fuel supplied from the outside to the fuel paths 16 and only a part thereof may suffice.

It is also noted that a heat resistant coating may be applied to the face in FIG. 2 which is exposed to the combustion gas.

[Second Embodiment]

The second embodiment of the present invention will be explained below based on FIG. 4 centering on a difference from the first embodiment. Although the structure of the liner 2 of the second embodiment is the same with the first embodiment in that the plurality of fuel paths formed in the longitudinal direction are provided within the liner 2 in the circumferential direction thereof as shown in FIG. 2, it is different from the first embodiment in that the liner 2 is completely closed except of a fuel-air mixed gas introducing section and a combustion gas discharging section of the liner 2 and that the air hole 40 is eliminated.

Further, because the flame holding area for holding combustion continuously and stably cannot be created as the air hole 40 of the first embodiment is eliminated, a flame holding area is created by providing a (bluff-body type) flame holder 60 at the downstream side of the fuel-air pre- mixer 13, instead of the air hole 40.

Fuel is supplied to and discharged from the fuel paths 16 in the same manner with the first embodiment. Further, all the combustion and dilution air is supplied to the combustion chamber via the fuel-air pre-mixer 13.

The present embodiment has an effect that the fuel paths 16 may be formed readily because they don't need to be formed by detouring the air hole, in addition to the effects obtained by the first embodiment.

Further, it becomes possible to equalize the distribution of combustion gas temperature at the outlet of the combustion chamber even more by eliminating the air hole and the air flow entering to the combustion chamber from the outer periphery of the liner 2.

It is noted that although the bluff-body type flame holder has been used as the flame holding means in the present embodiment, it is possible to use a Vgutter, round- nose Vgutter or jet-curtain type flame holder and the flame holding means is not confined to using those flame holders.

[Third Embodiment]

The third embodiment of the present invention will be explained below based on FIG. 5 centering on a difference from the second embodiment. The third embodiment is characterized in that the downstream side of the casing 3 whose upstream side is connected with the outlet of the compressor has the same diameter with the liner 2 and is connected with the upstream side of the liner 2 to give a function of a casing to the liner 2.

The third embodiment is also the same with the second embodiment in that the fuel paths 16 are provided within the liner 2, the fuel is supplied to and discharged from the fuel paths 16 and the dilution air is supplied to the combustion chamber via the fuel-air premixer 13.

The present embodiment has effects that the size of the combustion chamber may be reduced by eliminating the space between the liner 2 and the casing 3 and thereby, the length of a shaft connecting the compressor with the turbine may be shortened, thus allowing to reduce the size and weight of the whole system, in addition to the effects obtained by the second embodiment.

Further, the cooling effect of the liner 2 may be increased by structuring the liner 2 which has the additional function of the casing with the double-layer structure of the liner outer cylinder 14 and the liner inner cylinder 15, by providing the fuel paths 16 in the liner inner cylinder 15 and by forming it with a material having a high thermal conductivity. Moreover, a strength of the combustor 1 itself can be enhanced and the liner 2 can play the role of the casing fully by using a material having a high strength for the liner outer cylinder 14.

[Fourth Embodiment]

The fourth embodiment of the present invention will be explained below based on FIGs. 7 and 8. The present embodiment is characterized in that the sectional shape of the fuel path is changed. They can be applied to the fuel paths in the first through third embodiments.

As shown in FIG. 7, the fuel path 16 of the present embodiment provided in the liner inner cylinder 15 has an approximately square section in the longitudinal direction of the liner 2. That is, a face 22 of the fuel path 16 on the side of the face exposed to combustion gas projects in the direction opposite from the combustion chamber. The liner outer cylinder 14 and fin sections 23 are provided as shown in the figure.

Since the heat penetrating to an angled portion 21 has a more degree of freedom in relief thereof, a temperature distribution of the face 22 would become as indicated by a broken line in FIG. 8 in which the middle portion is high when a land 24 (a thickness between the face exposed to the combustion gas and the fuel path 16) is flat, i.e. the fuel path 16 has a square section. That is, because the face 22 is exposed to the highest temperature among the portions of the fuel path 16, a temperature of the middle portion of the face 22 becomes highest.

In general, hydro-carbon fuel such as Jet-A has a characteristic that it causes thermal decomposition and carbon is deposited (calking) under a certain high temperature. Accordingly, it becomes necessary to prevent the calking from occurring due to the partial high temperature portion described above when the hydro-carbon fuel is flown to the fuel paths 16.

Then, the calking is prevented by equalizing the temperature distribution of the face 22 as indicated by a solid line in FIG. 8 and by suppressing the partial high temperature portion from occurring by projecting the face 22 toward the fuel path 16 as a whole so as to have a peak at the middle portion thereof to increase the area of the face 22 and to increase the thickness of the land 24 as described above.

[Fifth Embodiment]

The fifth embodiment of the present invention will be explained below based on FIG. 9. A combustor 1 shown in FIG. 9 is characterized in that, in addition to the structure of the first embodiment shown in FIG. 1, a fuel temperature detecting sensor 62 is provided at the downstream side of each fuel path 16, a fuel flow amount control valve 61 is provided at the upstream side of each fuel path 16 and a fuel supply amount controller 80 for controlling a valve opening angle of the control valve 61 based on a detected value of the sensor 62 is provided. The other structure is the same with the embodiment shown in FIG. 1 and the explanation thereof is omitted here.

As shown in FIG. 9, a fuel temperature detected by each fuel temperature detecting sensor 62 is input to the fuel supply amount controller 80. The fuel supply amount controller 80 calculates an average value of each inputted detected value, finds a difference of +/- between the average value and each detected value and outputs a valve opening angle signal corresponding to the difference of +/- to each corresponding fuel flow amount control valve 61.

Then, the valve opening angle of the fuel amount control valve 61 is controlled corresponding to the signal and an amount of fuel supplied to each fuel path 16 is increased/decreased accordingly.

It is noted that the relationship between the difference of +/- between the average value and the detected value and the valve opening angle signal is found and stored in the fuel supply amount controller 80 in advance.

By constructing as described above, the liner 2 may be cooled equally and a partial melt-down of the liner 2 may be prevented even if a temperature of part of the liner 2 rises due to a partial change in combustion within the combustion chamber, by suppressing any local high temperature portion from occurring by increasing an amount of fuel flowing through the appropriate portion.

It is noted that although the valve opening angle of the fuel flow amount control valve 61 has been controlled based on the difference between the average value and each detected value of the fuel temperature in the present embodiment, the present invention is not confined only to that. That is, it is also possible to set an adequate value of fuel temperature at the downstream side of the fuel path 16 in advance and to control the valve opening angle of the fuel flow amount control valve 61 so that the fuel holds at that temperature.

The present embodiment has effects that it becomes possible to prevent the liner 2 from overheating as a whole and to prevent calking from occurring when the hydro-carbon fuel is used. It is needless to say that the present embodiment may be applied to the second and third embodiments.

[Sixth Embodiment]

The sixth embodiment of the present invention will be explained below based on FIG. 10. A combustor 1 shown in FIG. 10 is characterized in that, in addition to the structure of the first embodiment shown in FIG. 1, a combustion gas temperature detecting sensor 73 for detecting a temperature of combustion gas discharged from the combustion chamber in the direction of the center line 50 of the axis of rotation of each fuel-air premixer 13 is provided, an air flow amount control valve 72 is provided within the liner 2 at the upstream side of the fuel-air pre- mixer 13 and an air supply amount controller 90 for controlling a valve opening angle of the control valve 72 based on a detected value of the sensor 73 is provided. The other structure is the same with the embodiment shown in FIG. 1 and the explanation thereof is omitted here.

As shown in FIG. 10, a combustion gas temperature detected by each combustion gas temperature detecting sensor 73 is input to the air supply amount controller 90. The air supply amount controller 90 calculates an average value of each inputted detected value, finds a difference of +/- between the average value and each detected value and outputs a valve opening angle

signa… responding to the difference of +/- to each corresp… …g air flow amount control valve 72.

T… …n, the valve opening angle of the air amount control valve 72 is controlled corresponding to the signal and an amount of air supplied to the combustion chamber via each fuel-air pre-mixer 13 is increased/decreased accordingly.

It is noted that the relationship between the difference of +/- between the average value and the detected value and the valve opening angle signal is found and stored in the air supply amount controller 90 in advance.

By constructing as described above, a distribution of combustion gas temperature at the outlet of the liner 2 which might otherwise vary due to the circumferential distribution of air flow supplied from the compressor may be equalized and the melt-down of the turbine and the pressure loss in the combustion chamber may be reduced.

It is noted that although the valve opening angle of the air flow amount control valve 72 has been controlled based on the difference between the average value and each detected value of the combustion gas temperature in the present embodiment, the present invention is not confined only to that. That is, it is also possible to set an adequate value of a temperature of combustion gas at the outlet of the liner 2 (combustion gas at the inlet of the turbine) in advance and to control the valve opening angle of the air flow amount control valve 72 so that the combustion gas holds that temperature.

The present embodiment has effects that a high efficient turbine output can be obtained. It is also needless to say that the present embodiment may be applied to the second and third embodiments.

As described above, the flow paths of liquid fuel are formed within the liner which forms the combustion chamber and the liner is equally cooled in the gas turbine combustor of the present invention, so that the hot spot which would otherwise be produced at the downstream side of the air hole created through the liner can be prevented and a material having a good heat transfer characteristic, though its high temperature strength is small, may be used as the liner material.

Further, the air hole is eliminated from the liner and the flame holding area producing means is provided at the downstream side of the fuel-air pre-mixer, so that the gas the fuel paths within the liner can be readily formed and the distribution of combustion gas temperature at the outlet of the combustion chamber which would otherwise vary due to the air flowing in via the air hole may be equalized in the gas turbine combustor, in addition to the effects described above.

Still more, the size of the combustor may be reduced in the gas turbine combustor of the present invention constructed so as to give the function of the casing to the liner by eliminating the space between the liner and the casing, so that the length of the shaft connecting the compressor with the turbine can be shortened and the size and weight of the combustor and the whole system may be reduced.

As it is apparent from the above description, the present invention provides the gas turbine combustors in which the liner provided within the combustor casing can be cooled equally and the melt-down which would otherwise be caused by a hot spot produced therein can be prevented.

While preferred embodiments have been described, variations thereto will occur to those skilled in the art within the scope of the present inventive concepts which are delineated by the following claims.

Claims

1. A gas turbine combustor having a liner 2 forming a combustion chamber and a fuel-air pre-mixer 13, provided within and at the upstream side of said liner 2, for mixing liquid fuel with air supplied from a compressor and supplying it to said combustion chamber, said gas turbine combustor being characterized in that it comprises:

   a casing 3 whose upstream side is connected with the outlet side of said compressor and whose downstream side is connected with the downstream side of said liner 2 and which forms a space between it and said liner 2;

   a plurality of flow paths 16, provided within said liner 2, for flowing liquid fuel in the longitudinal direction of said liner 2;

   means 7, 8, 9 and 10, provided at one end of said liner 2, for supplying liquid fuel to said fuel paths 16;

   means 11, provided at the other end of said liner 2, for discharging the liquid fuel from said fuel paths 16; and

   an air hole 40, created through said liner 2, for supplying air which has been supplied to the space between said casing 3 and said liner 2 from said compressor to said combustion chamber as combustion air to produce a flame holding area.

2. A gas turbine combustor having a liner 2 forming a combustion chamber and a fuel-air pre-mixer 13, provided within and at the upstream side of said liner 2, for mixing liquid fuel with air supplied from a compressor and supplying it to said combustion chamber, said gas turbine combustor being characterized in that it comprises:

   a casing 3 whose upstream side is connected with the outlet side of said compressor and whose downstream side is connected with the downstream side of said liner 2 and which forms a space between it and said liner 2;

   a plurality of flow paths 16, provided within said liner 2, for flowing liquid fuel in the longitudinal direction of said liner 2;

   means 7, 8, 9 and 10, provided at one end of said liner 2, for supplying liquid fuel to said fuel paths 16;

   means 11, provided at the other end of said

liner 2, for discharging the liquid fuel from said fuel paths 16; and

flame holding area producing means 60 provided at the downstream side of said fuel-air premixer 13.

3. A gas turbine combustor having a liner 2 forming a combustion chamber and a fuel-air pre-mixer 13, provided within and at the upstream side of said liner 2, for mixing liquid fuel with air supplied from a compressor and supplying it to said combustion chamber, said gas turbine combustor being characterized in that it comprises:

a casing 3 whose upstream side is connected with the outlet side of said compressor and whose downstream side is connected with the upstream side of said liner 2;

a plurality of flow paths 16, provided within said liner 2, for flowing liquid fuel in the longitudinal direction of said liner 2;

means 7, 8, 9 and 10, provided within said liner 2, for supplying liquid fuel to said fuel paths 16;

means 11, provided at the other end of said liner 2, for discharging the liquid fuel from said fuel paths 16; and

flame holding area producing means 60 provided at the downstream side of said fuel-air premixer 13.

4. The gas turbine combustor according to Claim 3, wherein said liner 2 has a double-layer structure with an outer cylinder 14 and an inner cylinder 15 in which said fuel flow paths 16 are created and wherein said inner cylinder 15 is made of a material having a high heat transfer characteristic and said outer cylinder 14 is made of a material having a high strength.

5. The gas turbine combustor according to any one of Claims 1 through 3, wherein a sectional shape of said fuel paths 16 within said liner 2 perpendicular to the direction of the flow is approximately square and the section face of the combustion chamber side projects in the direction opposite from the combustion chamber.

6. The gas turbine combustor according to any one of Claims 1 through 3, wherein means 62 for detecting a temperature of fuel flowing through each of said fuel paths 16 is provided at the fuel discharge side and means 61 for controlling an amount of fuel supplied to each fuel path 16 in accordance to the detected fuel temperature is provided at the fuel supply side.

7. The gas turbine combustor according to any one of Claims 1 through 3, wherein means 73 for detecting a temperature of combustion gas discharged from said liner 2 is provided in the direction of center line of the axis of rotation of said fuel-air pre-mixer 13 and means 72 and 90 for controlling an amount of air supplied to said combustion chamber in accordance to the detected combustion gas temperature are provided at the upstream side of said fuel-air pre-mixer 13 within said liner 2.

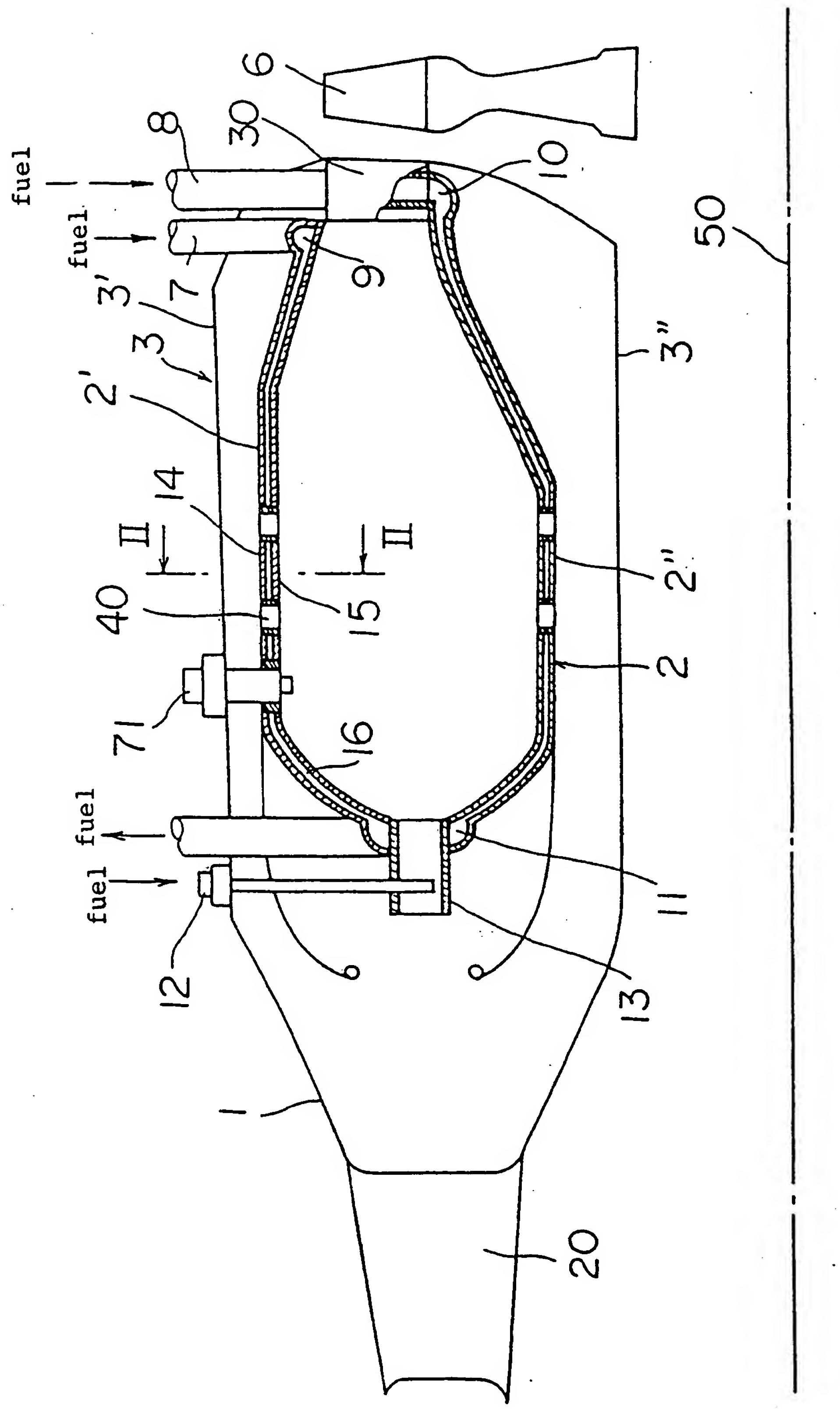

fuel
fuel
fuel
fuel
8
30
6
10
7
3'
3
2'
9
50
3"
14
II
II
40
15
2"
2
71
16
11
12
13
1
20

Fig. 1

Fig. 2

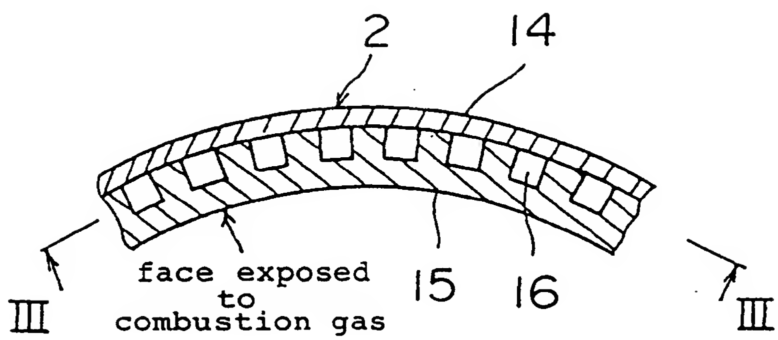
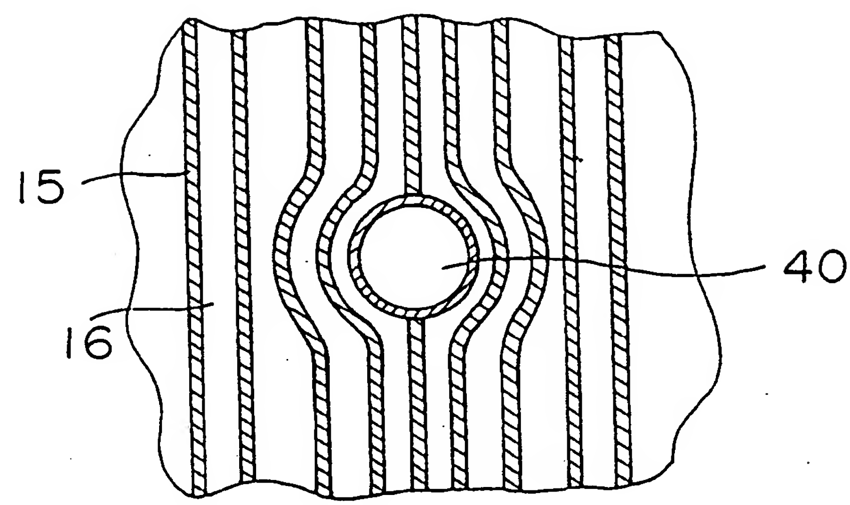


Fig. 3



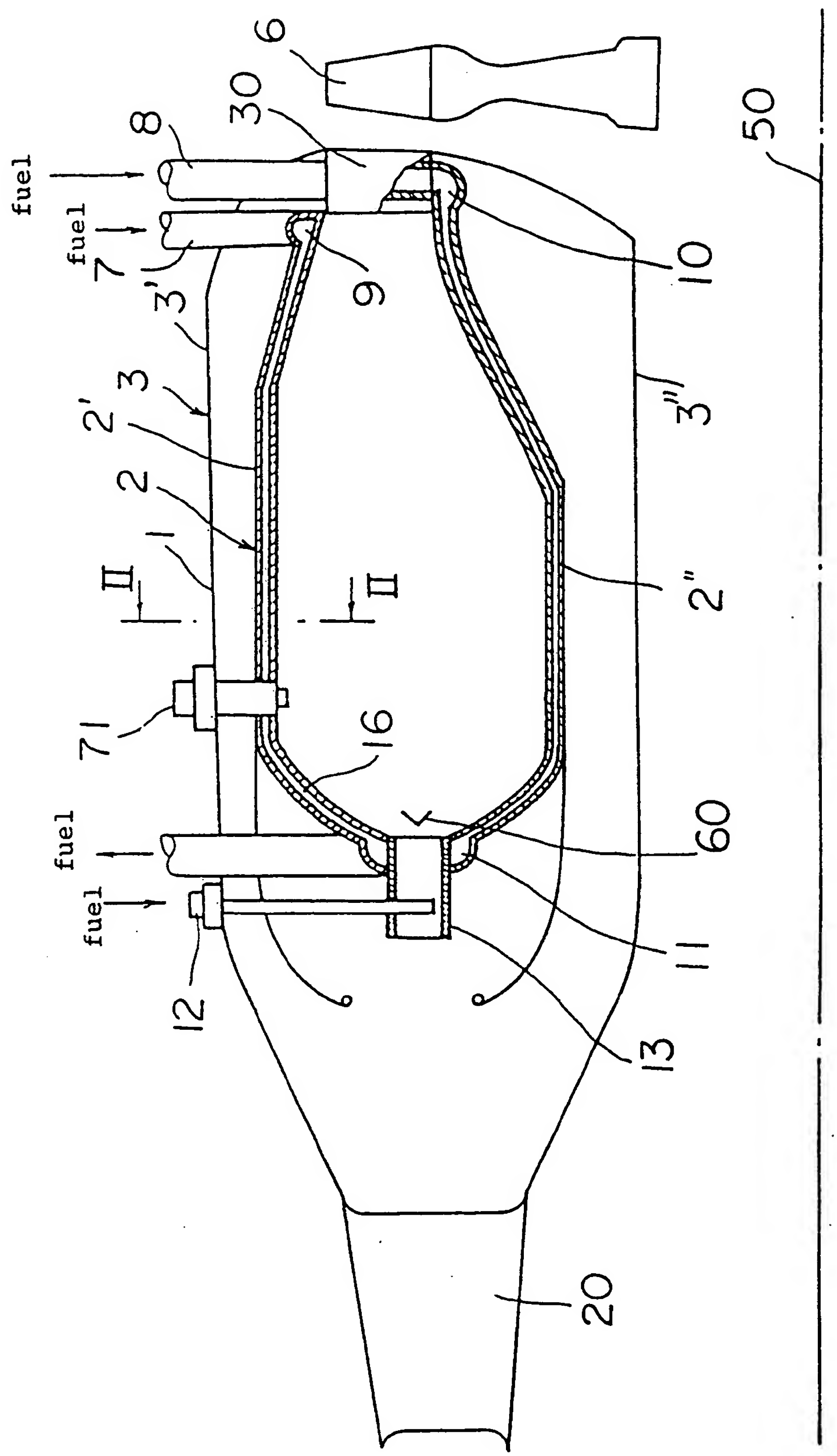

fuel
fuel
fuel
fuel
8
30
6
7
3'
3
2'
2
1
II
II
71
16
60
11
13
12
20
50
10
9
3"
2"

Fig. 4

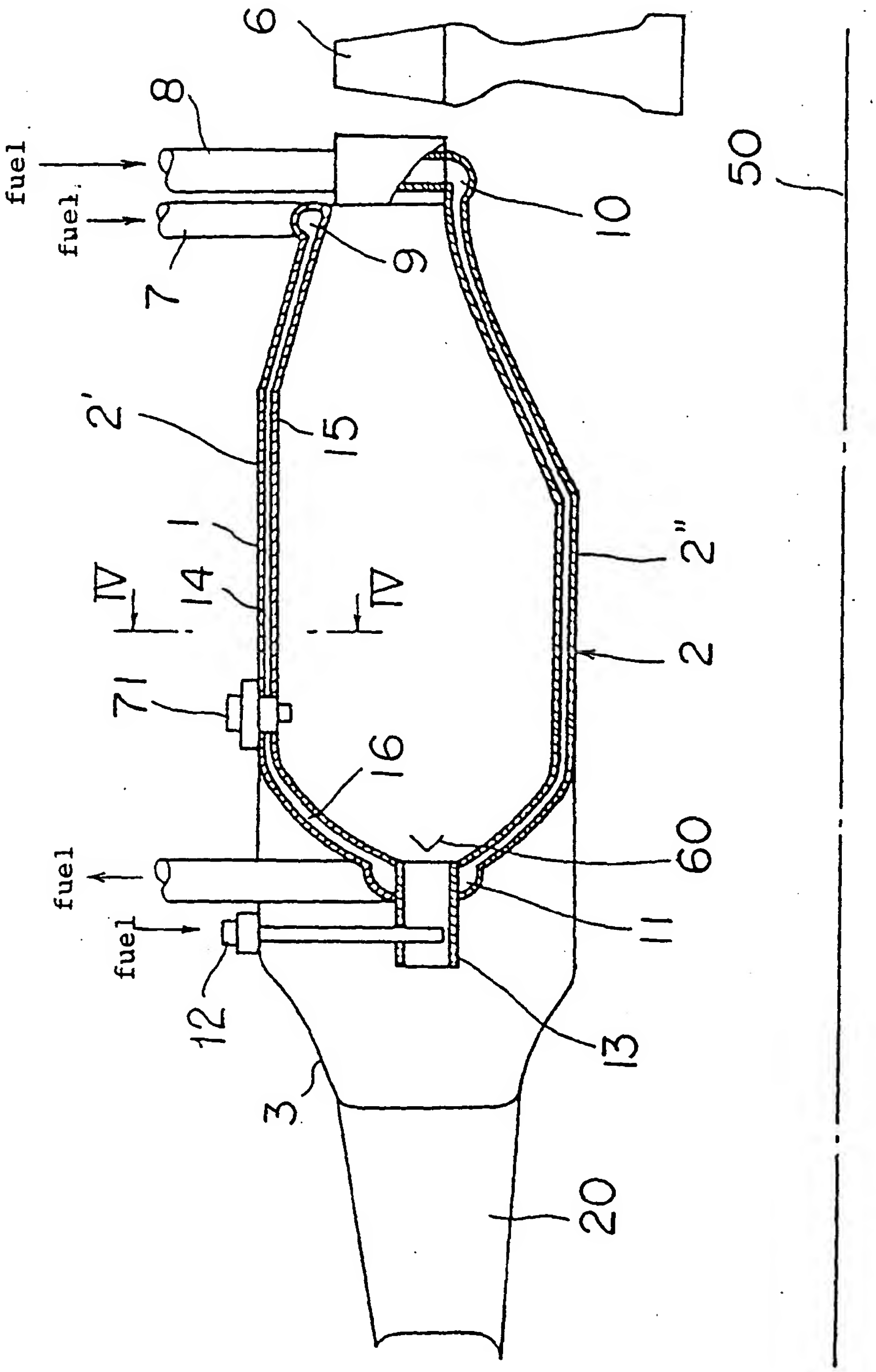

fuel
fuel
8
6
7
9
10
50
2'
15
1
14
IV
IV
2"
2
71
16
60
11
fuel
fuel
12
13
3
20

Fig. 5

Fig. 6

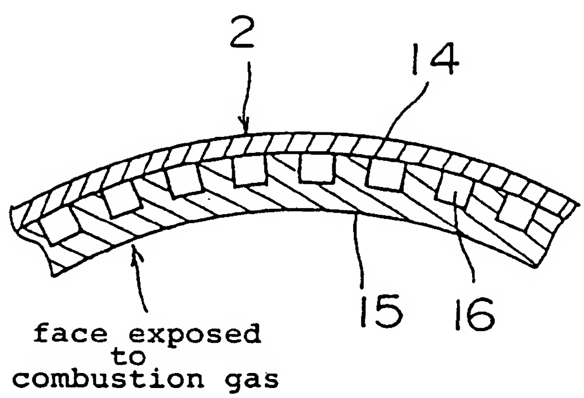


Fig. 7

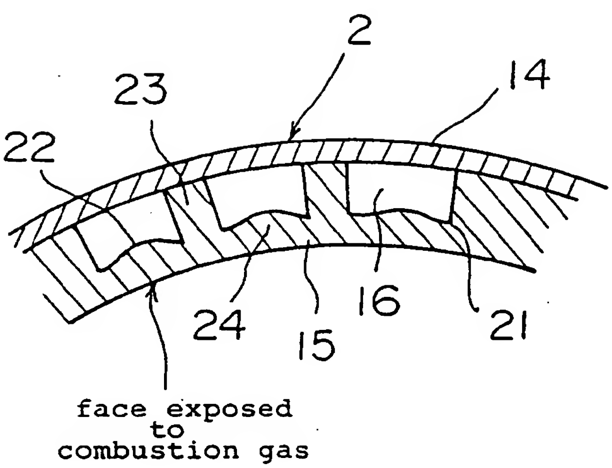

2
14
23
22
24
15
16
21
face exposed to combustion gas

Fig. 8

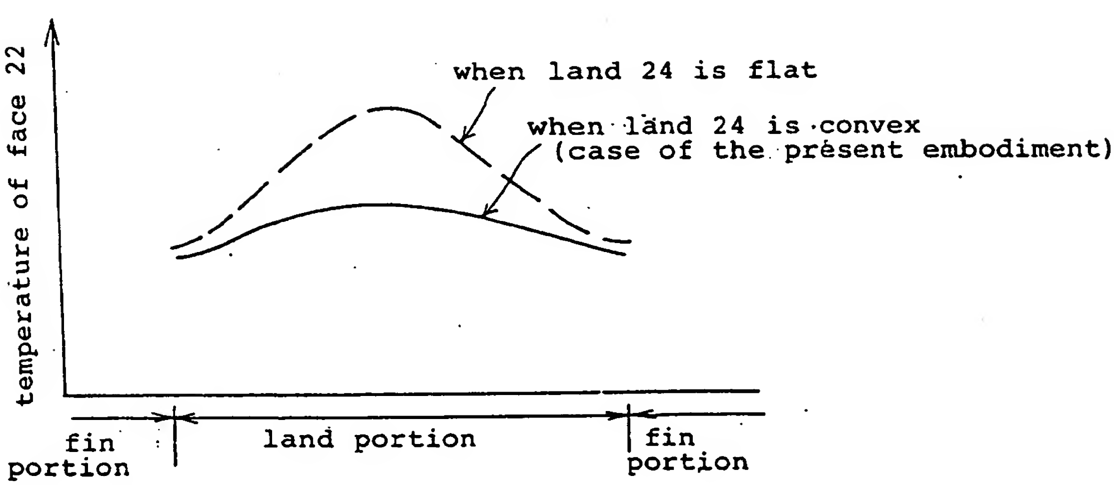
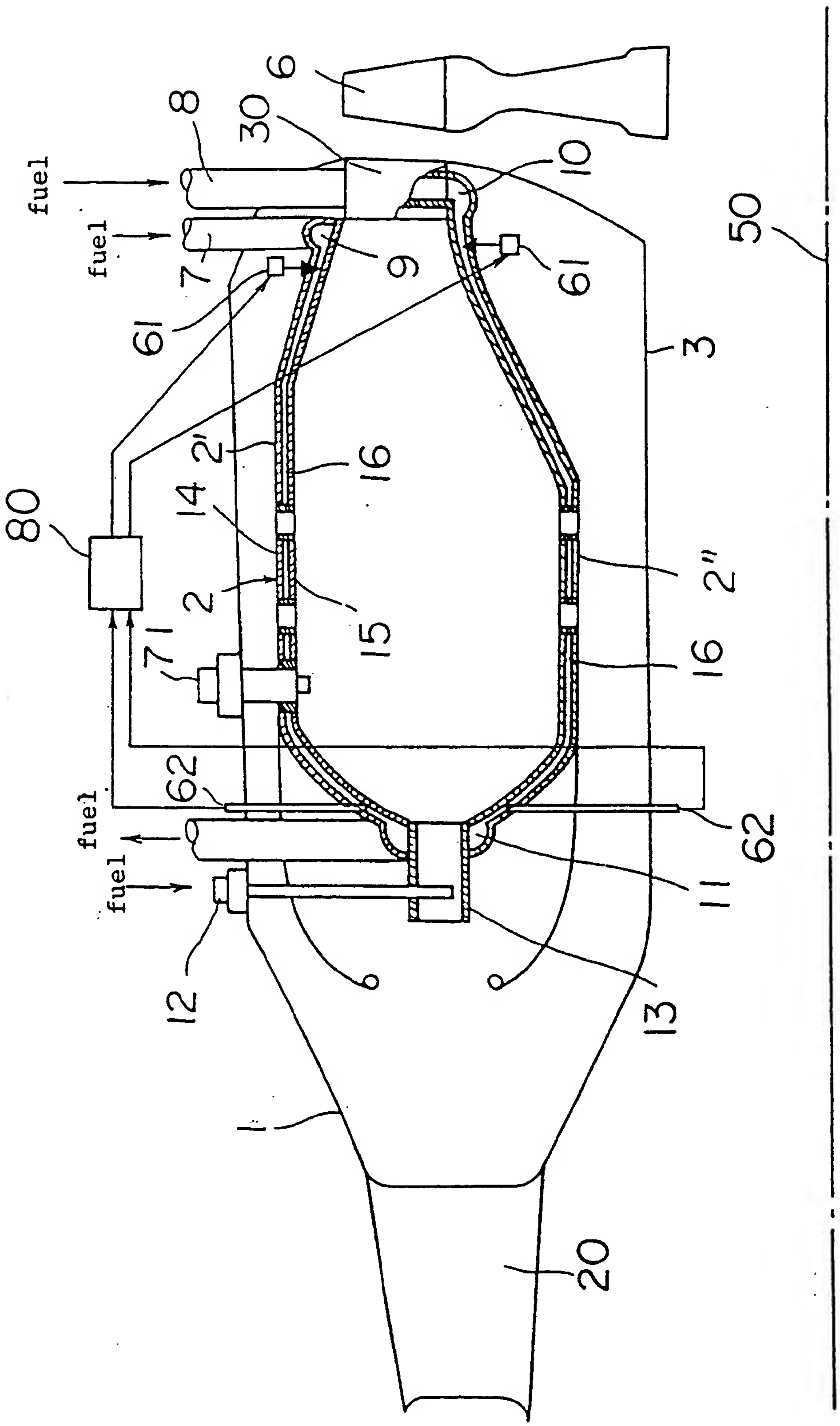

temperature of face 22
when land 24 is flat
when land 24 is convex (case of the present embodiment)
fin portion
land portion
fin portion

Fig. 9


fuel
fuel
fuel
fuel
80
6
8
30
10
50
9
61
61
7
3
2'
16
14
2
2"
15
71
16
62
62
11
12
13
1
20

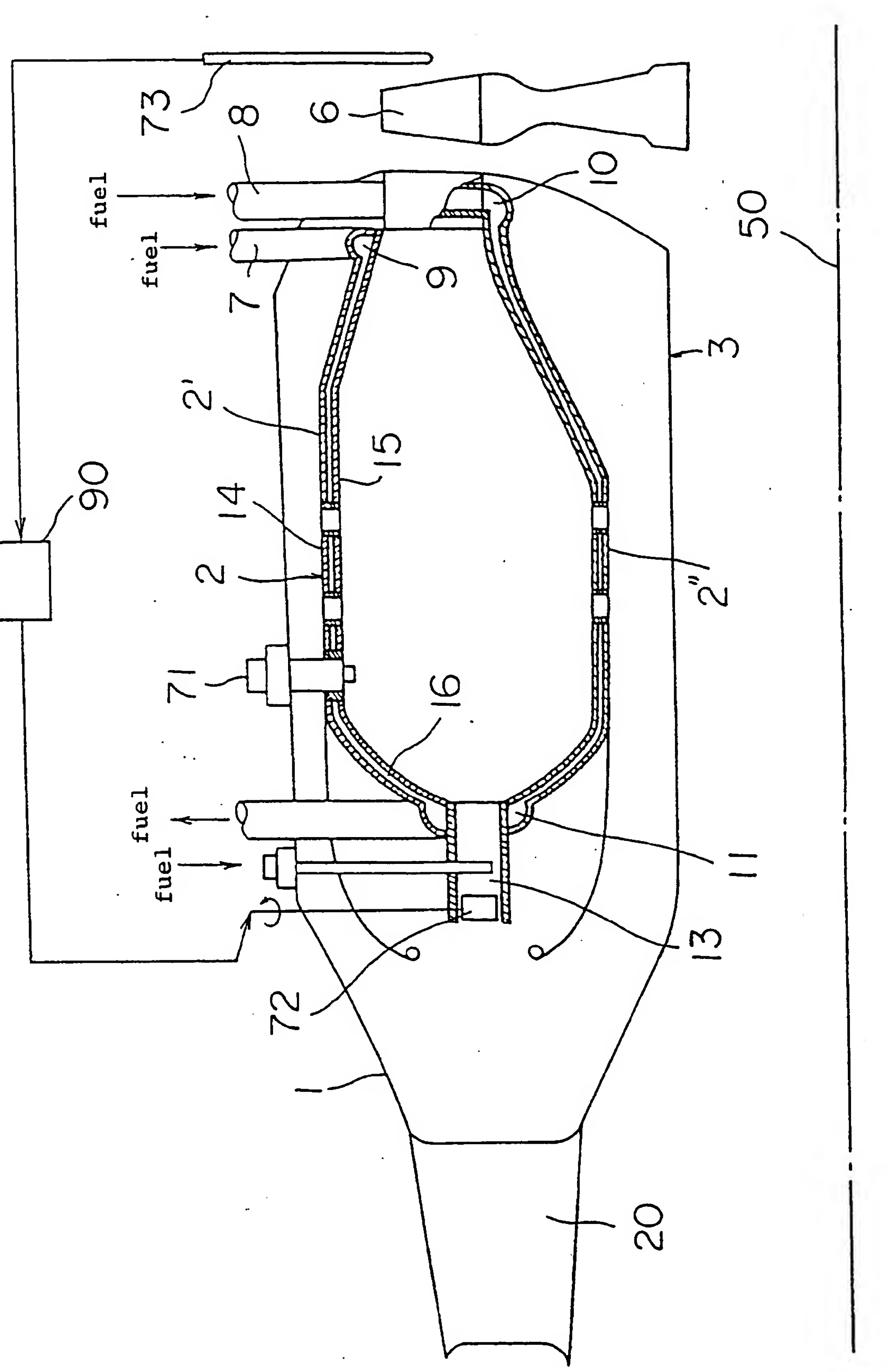
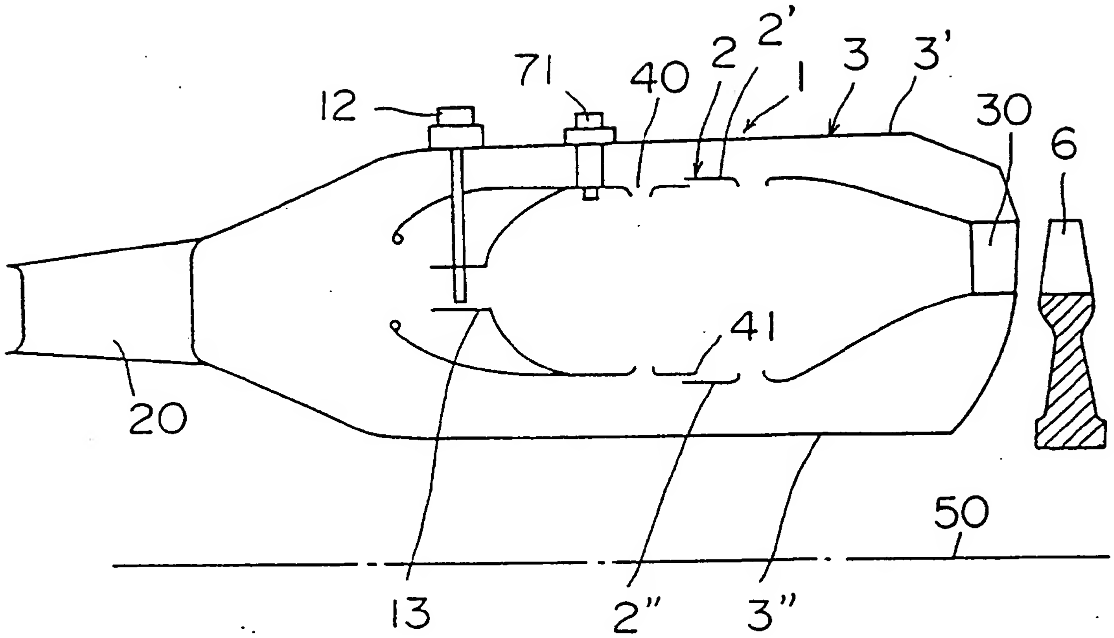


Fig. 10

Fig. 11



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(71) Applicant:
MITSUBISHI JUKOGYO KABUSHIKI KAISHA
Tokyo 100 (JP)

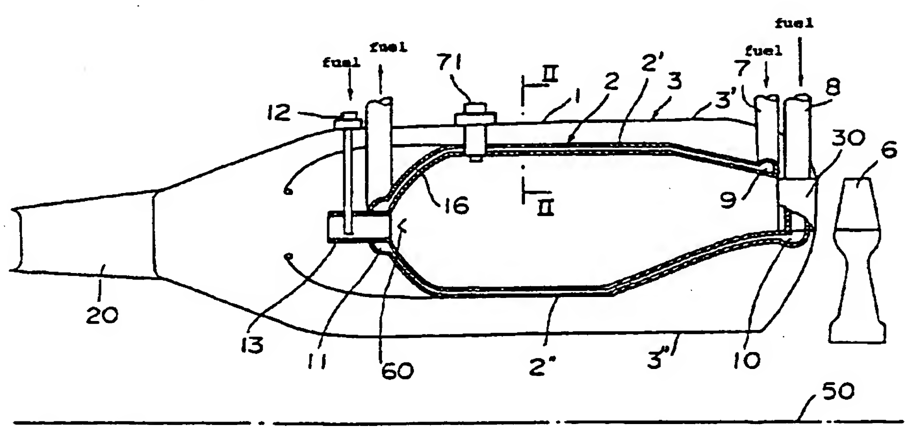
(72) Inventor:
Matsuhama, Masaaki,
Nagoya Guid & Pro. sys.
Komaki-shi, Aichi-ken (JP)

(74) Representative:
Henkel, Feiler, Hänzel
Möhlstrasse 37
81675 München (DE)

(54) **Gas turbine combustor**

(57) A gas turbine combustor in which an inequality of distribution of temperature at the outlet of the combustor which is caused by cooling air introduced to the combustor to cool it is prevented. A liner 2 having an outer liner 2' and an inner liner 2" is disposed within a casing 3 composing the gas turbine combustor 1. The liner 2 is composed of a liner inner cylinder 15 in which liner cooling paths 16 are created and a liner outer cylinder 14. Fuel supplied via upstream side manifolds 9 and 10 flows through the liner cooling paths 16 and is discharged from a downstream side manifold 11 after cooling the liner 2. The fuel is boosted by a pump and is supplied to a fuel-air pre- mixer 13 from a fuel supply port 12 to be burned in the combustion chamber.

Fig. 4



EP 0 725 253 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 96 10 1281

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US 3 379 009 A (SHARP JAMES WALLER ET AL) 23 April 1968 * column 2, line 45 - column 3, line 15; figures *	1-3,6,7 5	F23R3/00 F23R3/28 F02C7/224 //F02K9/64
Y	US 4 781 019 A (WAGNER WILLIAM R) 1 November 1988 * figures *	5	
A	EP 0 284 410 A (INST SPACE ASTRONAUT SCIENCE ;ISHIKAWAJIMA HARIMA HEAVY IND (JP)) 28 September 1988 * abstract; figures *	1-3	
A	GB 2 119 447 A (KERSHAW H A) 16 November 1983 * abstract *	1-3	
A	DE 41 37 638 A (MOTOREN TURBINEN UNION) 3 June 1993 * abstract *	1-3	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23R F02C F02K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 January 1999	Argentini, A

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19-01-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3379009 A	23-04-1968	DE 1291166 B	
		FR 1436390 A	21-07-1966
		GB 1102572 A	
US 4781019 A	01-11-1988	NONE	
EP 0284410 A	28-09-1988	JP 1953058 C	28-07-1995
		JP 6059502 B	10-08-1994
		JP 63238923 A	05-10-1988
		US 4856163 A	15-08-1989
		US 4909032 A	20-03-1990
GB 2119447 A	16-11-1983	NONE	
DE 4137638 A	03-06-1993	NONE	

EPO FORM P0459

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